2. MISSION, STRATEGIES, AND PROCESS OVERVIEW

The EM program is responsible for cleanup and long-term stewardship of the environmental legacy of nuclear weapons research, production, and testing and of DOE-funded nuclear energy research in the United States. These activities collectively produced large volumes of nuclear materials, spent nuclear fuel, radioactive waste, and hazardous waste, resulting in contaminated facilities, soil, and groundwater at 113 sites across the country. EM manages some of the most technically challenging and complex work of any environmental program in the world. Within EM, OST manages the development of science and technology to provide solutions to problems encountered in completing the cleanup-stewardship mission.

The EM cleanup-stewardship program embodies the guiding principles depicted to the right. In addition, EM has identified four critical objectives that research and development investments must attain in order to support successful completion of the cleanup-stewardship mission. These objectives, described in the *EM Strategic Plan for Science and Technology,* are:

- **Meet the high-priority needs** identified by cleanup project managers, including those on the critical path to site closure and those that represent major technology gaps in project completion.
- **Reduce the cost** of EM's costliest cleanup projects by aligning science and technology investments with EM's major cleanup problems.
- **Reduce technological and programmatic risk** so those critical cleanup projects will be completed on time and within budget.
- **Accelerate and increase technology deployments** by closing the gap between development and use.

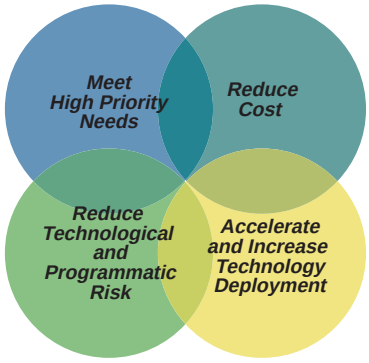
The EM environmental program is comprised of two distinct, separable, yet closely related and complementary phases. The cleanup phase is comprised of all those activities necessary to clean up or dispose the wastes and materials encountered in the environmental management mission to a well-defined, agreed-upon level, called a cleanup end state. The end state reflects a balance of risk, cost, stakeholder values, regulations and technology capability. However, in many cases the end state does not completely eliminate all the hazards presented by these wastes and materials. In such cases it is necessary to provide an adequate level of protection to human health and the environment from the hazards that remain. This phase of the environmental program is called long-term stewardship. Though both phases are equally important, the urgency of many of the cleanup problems has resulted in a much greater focus and attention on cleanup than on long-term stewardship. As cleanup activities have progressed, long-term stewardship is receiving more attention.

The relationship between these two aspects of the cleanup-stewardship mission is illustrated in Figure 2.1. The figure also illustrates that throughout cleanup-stewardship activities there is need for scientific and technological solutions to problems encountered in completing these challenging tasks. New scientific knowledge and information and new technologies provide the basis for better planning and decisions that are necessary to complete cleanup-stewardship in a better, quicker and less expensive manner.

The EM cleanup-stewardship mission embodies six guiding principles:

- ***Protect workers, the public and the environment;***
- ***Reduce long-term safety risks;***
- ***Bring science and technology expertise to bear on individual projects;***
- ***Strengthen program and project managment to ensure the Department is getting the most for the taxpayer dollar;***
- ***Earn the public's confidence that the Department will meet its responsiblities by meeting commitments, involving parties throughout the process, opening lines of communication, and ensuring a common understanding of the issues and decisions that must be made; and***
- ***Build long-term stewardship into cleanup plans.***

EM Program Critical Objectives



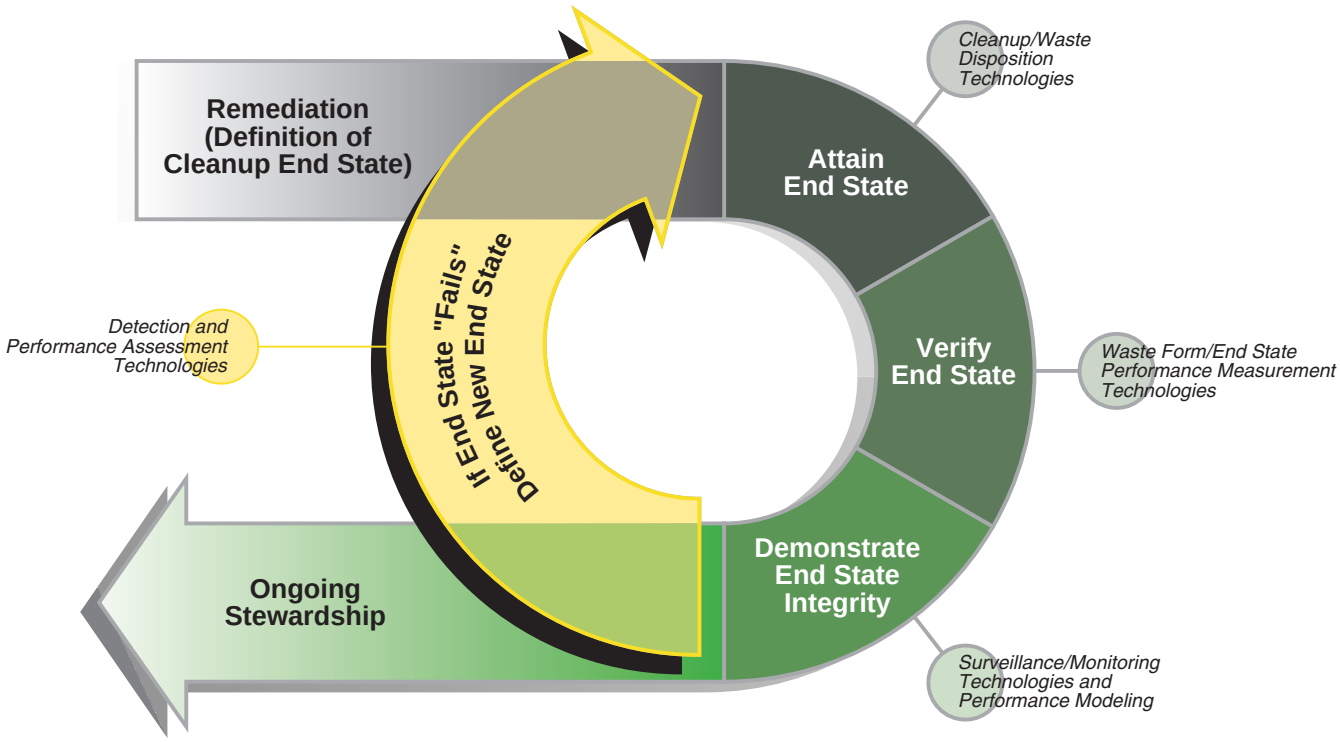


Figure 2.1 Relationship of clean-up end states and long-term stewardship

2.1 Mission

The OST mission is to manage and direct a national, solution-oriented research and development program that provides the scientific foundation, new approaches, and new technologies that bring about significant reductions in risk, cost, and schedule for completion of the EM cleanup-stewardship mission. OST provides the full range of science and technology resources and capabilities—from a targeted basic research program through development, demonstration, and deployment and technical assistance—needed to deliver and support fully developed, deployable scientific and technological solutions to EM cleanup and long-term stewardship problems. The relationship of the OST mission to the overall EM cleanup-stewardship mission is illustrated in Figure 2.2

In addition to providing the science and technology to support cleanup and long-term stewardship, OST has two related responsibilities. Because of the major implications of science and technology on cleanup end states and subsequent long-term stewardship, the Office of Long-Term Stewardship has been created and established within OST. The Office of Long-Term Stewardship is responsible to establish policy and provide guidance for this phase of the cleanup-stewardship mission. Also, because the DOE laboratories are a critical resource in completing the EM mission, OST has responsibility for providing management oversight of DOE EM laboratories through a laboratory management team. This management oversight responsibility includes institutional planning, policy and processes, and management contracts, to enhance and maintain the overall strength and vitality of the laboratories in contributing to the goals of the EM cleanup program.

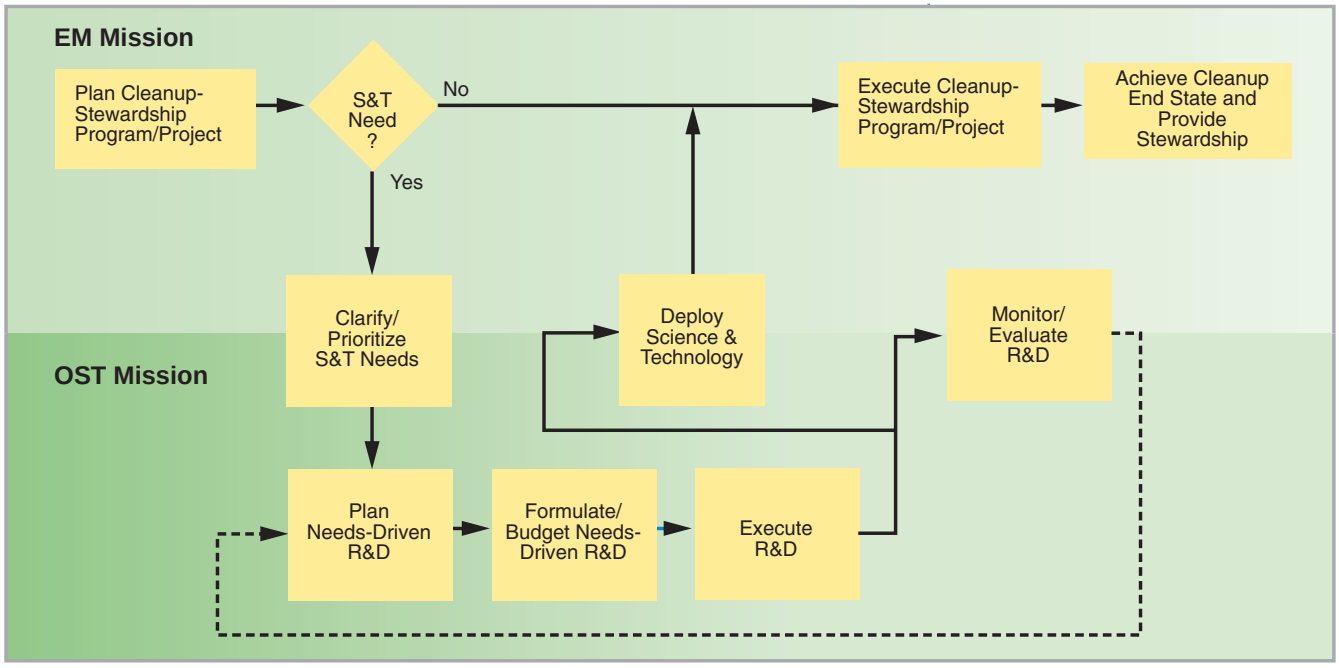


Figure 2.2 Relationship of OST and EM missions

This management plan describes how OST manages research and development activities to support the EM cleanup-stewardship program with a full range of science and technology resources and capabilities. The development of long-term stewardship policy and guidance is described in *Strategy for Developing and Implementing Needed Science and Technology to Support Long-Term Stewardship*. The management of the EM Laboratories is described in *Filling the Role of Cognizant Secretarial Officer: A Management Plan for the Office of Environmental Management Laboratories.*

2.2 Strategies

To achieve a comprehensive, integrated approach to developing and providing science and technology solutions, EM has separated the site cleanup needs into a set of five problem areas. A focus area has been established to plan and manage EM's research and development investments to develop solutions for each problem area. This focus area centered approach, illustrated in Figure 2.3, provides the basis for making EM's science and technology investments solution-oriented and an integral part of cleanup-stewardship activities.

The EM technical program strategies described in the *EM Strategic Plan for Science and Technology* are critical influences on the OST and focus area management approach. These strategies will help ensure that research and development investments are focused on providing the technologies and support that cleanup project managers require to successfully complete the EM mission.

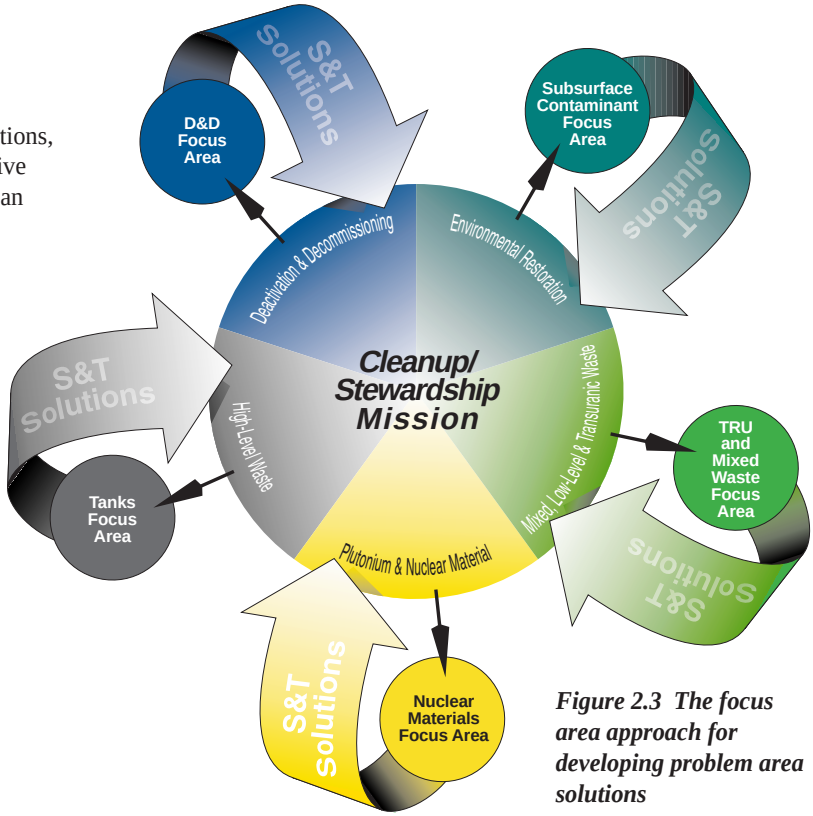


Figure 2.3 The focus area approach for developing problem area solutions

EM investments in research and development must be:

- **Needs Driven -** Activities will be focused to support implementation decisions, to create solutions to difficult problems, to enable actions that significantly reduce the cost and duration of cleanup while maintaining or enhancing safety, or to fundamentally transform the nature of the problem.
- **Fully Integrated with Cleanup Programs -** Activities will be linked directly to cleanup program goals, with financial accountability transitioning from the science and technology funding to the cleanup projects as technologies move toward implementation.
- **Comprehensive in Scope -** Activities will cover the full range of science and technology (i.e., basic research to technology development to technology demonstration to technical assistance supporting implementation).
- **Credible Decision Process -** Processes used to establish priorities, set program and project direction, allocate funding, and select project teams are based on a clear set of criteria and are applied in an open, transparent manner.

In addition to the strategies in the *EM Strategic Plan for Science and Technology* OST will also emphasize the following management strategies:

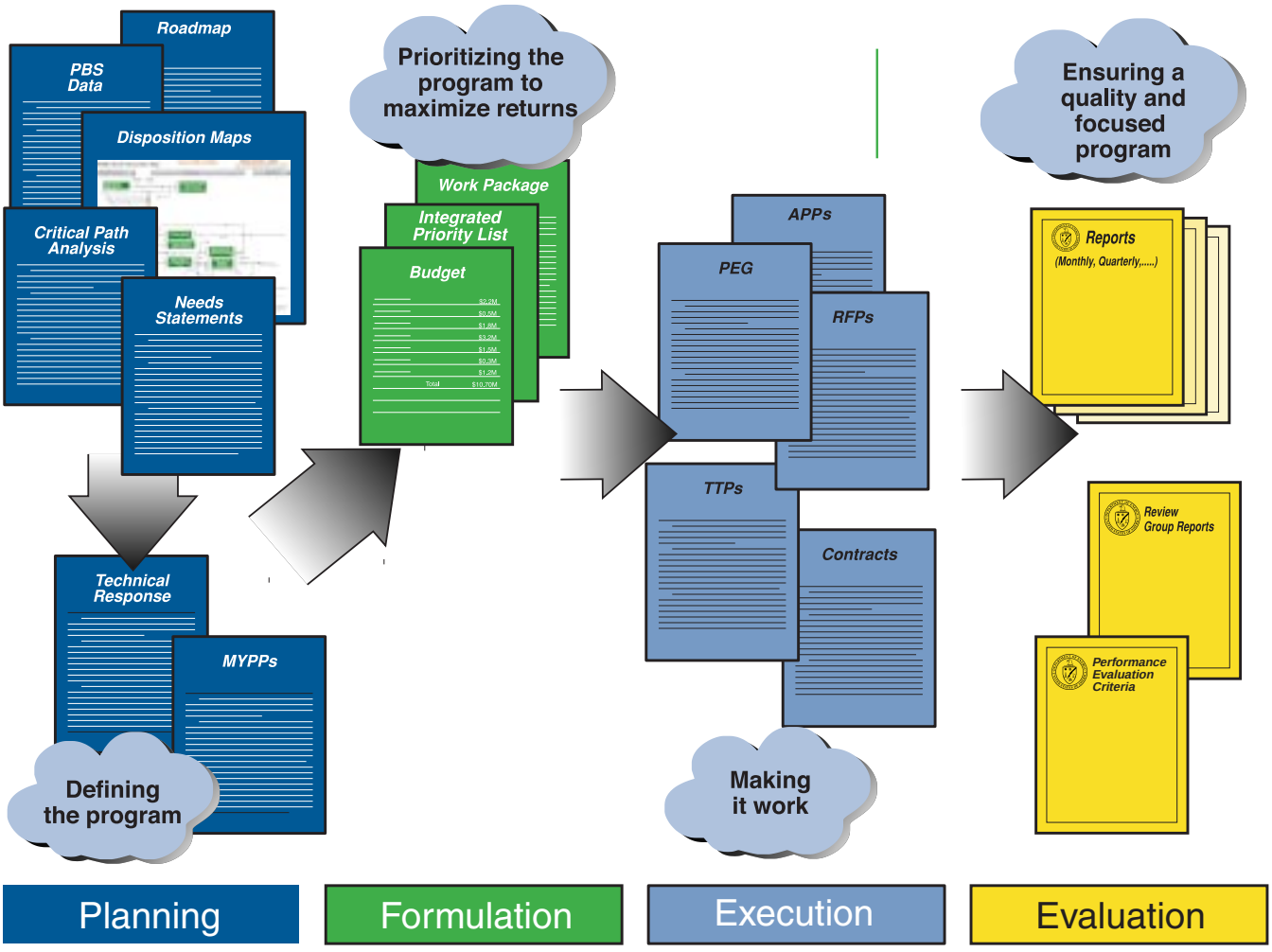
- **Fully Integrate with Private Industry -** Planning for deployment will be carried out early in the technology development process. For technologies developed through the national laboratories, private industry partners will be identified during technology development efforts to enhance widespread deployment opportunities. In many instances private industry will be the primary developer and make the technology available for DOE's use through the site contractor. In many cases, commercial products are already available or may need only minor adaptation. For technologies that will be deployed directly by the EM user programs, end users are engaged during the development stage.
- **Employ Sound Business Practices -** OST will conduct research and development, demonstration, and deployment activities in a way that ensures the greatest possible return from the investment of funds, time, and human resources. OST will also employ practices that reduce risk and provide for environmental cleanup to the greatest extent practical.
- **Engage Stakeholders –** Focus areas will work with end users to engage regulators and stakeholders, as appropriate, in the development process to keep them informed of technology improvements and to determine acceptance of a "class" of technologies such as incinerator alternatives. Individual sites will retain the responsibility for stakeholder acceptance of specific technology deployment.

2.3 Process Overview - *Creating Solutions to Cleanup Needs*

The OST management process provides a disciplined, documented approach to implement the above strategies. This approach ensures that EM investments in research and development are planned and managed based on the science and technology needs of the cleanup-stewardship mission. EM has adopted systems engineering and technology roadmapping as key tools in this approach. The systems engineering discipline identifies and defines cleanup-stewardship science and technology needs, ensuring that cleanup program and project decisions and implementation are needs driven, technically defensible, cost-effective, and satisfy stakeholders and regulators. Technology roadmapping helps define and focus research and development investments and activities to ensure that they are solution oriented and provide the maximum benefit to the EM cleanup program.

The OST management process is designed to create and integrate the information required to plan and execute needs-driven, solution-oriented research and development. The development, documentation and flow of information through the OST management process are illustrated in Figure 2.4. The planning information obtained from science and technology needs statements, Project Baseline Summary (PBS) data, disposition maps and critical path analyses is used to develop technical responses and focus area multi-year

Figure 2.4 An overview of the OST management process



program plans (MYPPs). These are used to develop work packages and support budget submissions during program formulation. Research and development activities are implemented through program execution guidance (PEG), technical task plans (TTPs), requests for proposals (RFPs) and subsequent contracts and awards during program execution. Performance criteria have been established to evaluate program performance. Performance evaluations are documented in reports prepared by various review groups. The functions and processes that create and manage this information and implement the research and development program are described in the following sections.

The involvement of EM cleanup project managers is essential at each step in the program development and execution process. They are the "customers" or end users of the science and technology solutions provided by the OST research and development activities. EM cleanup project managers are the operations facility and process owners throughout the DOE complex. They are responsible for remedial action, pollution prevention, deactivation and decommissioning, safe management of waste, and disposition of nuclear material and spent fuel. In addition to achieving remediation or waste disposition end states, the sites are also responsible for long-term stewardship after cleanup is completed. EM cleanup project manager participation, review, validation, and ultimate ownership of the science and technology solutions ensures that science and technology investments properly flow through the technology development process and result in the implementation of solutions to EM cleanup-stewardship problems. Cleanup project manager involvement also serves to ensure stakeholder involvement is provided during development, demonstration, and deployment of new technologies.

Program Planning – Defining the Program

In simplest, most basic terms, the objective of program planning is to identify the science and technology needs of the cleanup-stewardship activities and to develop a research and development program plan that provides effective solutions. The planning process is comprised of the following series of activities and interactions.

Data Collection and Analysis - Defining the Problems to be Solved

Identification of cleanup-stewardship science and technology needs is the first step in developing effective solutions. EM program and project managers develop cleanup-stewardship program and project baselines that describe how the cleanup-stewardship activities will be performed and completed. The baseline identifies all the processes and functions necessary to complete the project and defines the performance requirements these processes and functions must meet. If a performance requirement can not be met by currently available technologies the requirement is identified as a science and technology need. The sites annually update the project baselines and identify science and technology needs. It is essential that these needs are defined and validated by the project managers who are responsible for performing the cleanup-stewardship actions. EM relies heavily on their input as the primary source for definition and communication of site-specific needs.

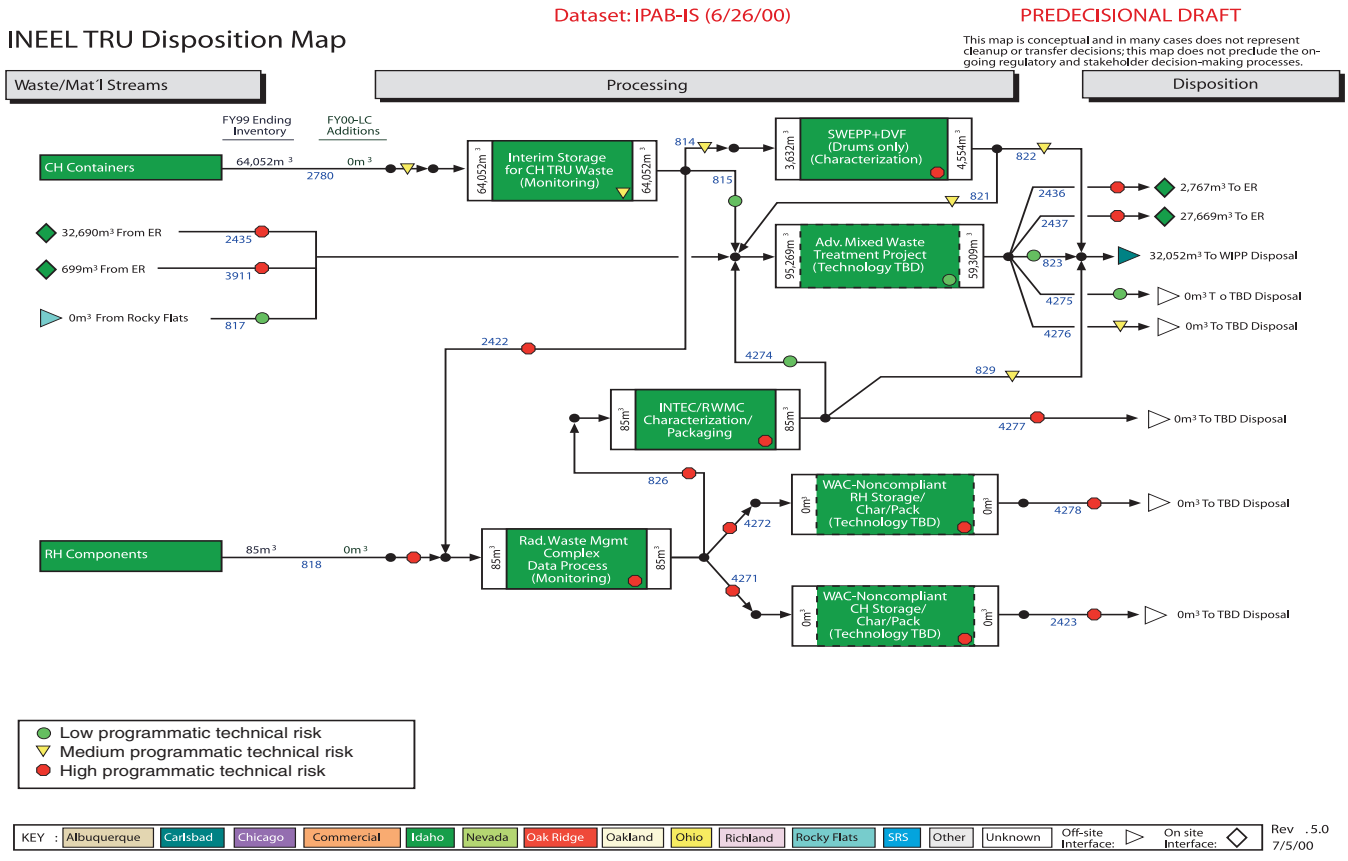
Science and technology needs are currently derived from the following data sets:

- Cleanup project manager need statements — provides information on the priority, timing (including potential deployment/implementation schedule), and technical detail associated with a site problem.
- Disposition maps — illustrates the technology risk levels and the maturity of the planned technological solution (e.g., bench-scale prototype to an existing operating facility). An example disposition map with programmatic risk level is shown in Figure 2.5. (In the cases of the Environmental Restoration and Deactivation and Decommissioning problem areas the disposition or life cycle maps are currently being developed.)

- Critical pathway analyses — provides an assessment of the progress of the planned technological solution on a schedule consistent with cleanup project key activities and milestones on the path to complete cleanup of the site.
- Project Baseline Summary information — includes life cycle cost; schedule; current technical approach; and environment, safety and health risk.
- External program reviews — longer-term programmatic science and technology needs are identified in reports of reviews by external bodies such as the National Academy of Sciences, the Strategic Laboratory Council, and others.
- Roadmaps — project-level and program-level roadmaps, developed by end users for their problem area, identify science and technology needs at both the site specific and national level and for both the near- and long-term time frames.

These data sets provide insight into the size (cost and magnitude) and complexity of the technical issues facing EM. They also identify the cleanup project manager, when the solution is needed, and the impact of not addressing the need. Taken in aggregate, they provide the basis for development of the technical responses.

Figure 2.5 An illustration of a disposition map with programmatic risk level



Elements of project characterization:

- ***Target waste streams***
- ***Waste quantities to be processed***
- ***Processing schedule***
- ***System processing rate requirements***
- ***Regulatory requirements and issues***
- ***Commercialization potential***
- ***Stakeholder issues***
- ***Environmental risks, programmatic risks***
- ***Technology and maturity***
- ***Disposition of treatment residuals***
- ***Stewardship requirements***

Technical Response Development - New and Improved Solutions

A technical response is a proposed solution to a science or technology need. Technical responses are developed through a dialogue, facilitated by the focus area, between the end users and the science and technology developers and suppliers. Commercially available technologies and systems that are applicable to a given cleanup project should be identified in the process of developing the project baseline. However, in many cases line programs may not be aware of cutting-edge technologies. As part of developing a technical response, the focus areas identify potentially applicable existing technologies as well as propose the development of new technologies. It is important to gather enough information during the preparation of a technical response to be able to determine if a solution can be purchased or must be developed. "Make-vs-buy" considerations should always be a part of the technical response development. The more completely the cleanup-stewardship project is characterized, the more informed and comprehensive the technical response will be.

Successful development and deployment of science and technology solutions depend on integrating technical responses with cleanup-stewardship activities and schedules. This integration includes joint planning to ensure (a) budgets are adequate to support technology development efforts, (b) schedules are aligned with technology insertion points, and (c) cleanup programs have the financial resources and technical support to enable implementation and deployment of new solutions. When the technical response involves multi-year research and development activities, the ongoing research and development investments are evaluated at key decision points to determine if the effort should be continued or if an alternate strategy is more appropriate. Cleanup project managers are involved in these project evaluations during the midyear reviews to ensure continued commitment to implementation of the solution.

Formulation – Prioritizing the Program to Maximize Returns

The complexity and duration of the cleanup-stewardship effort, combined with budget constraints and regulatory changes, requires EM to carefully prioritize and sequence cleanup projects. These same factors drive a continuous effort within EM to rank and prioritize research and development investments. The prioritization efforts are used to assist in decisionmaking and are the basis for out-year budget requests.

The prioritization process is iterative and integrative, beginning at the focus area level and progressing to higher levels and greater breadth with each step. At the focus area level technical responses to each science and technology need are prepared. To ensure that a technical response meets a cleanup need, only those technical responses that are endorsed by a cleanup project manager are considered for integration and prioritization in the portfolio. Prioritization is first done by the focus areas, then thoroughly reviewed, changed as necessary, and approved by the appropriate Focus Area User Steering Committee.

Endorsed, approved technical responses are compiled into work packages. These focus area-developed work packages represent a set of related technical responses to site problems. The work packages from all the focus areas are collectively submitted to a national prioritization process that uses a multi-attribute analysis using evaluation criteria illustrated in Figure 2.6. In this manner, the full set of focus area work packages are listed in priority order. The output of the prioritization system goes through a final review cycle by the DOE field office managers and EM deputy assistant secretaries. This integrated priority list (IPL) is the basis for the congressional budget request for EM's investment portfolio.

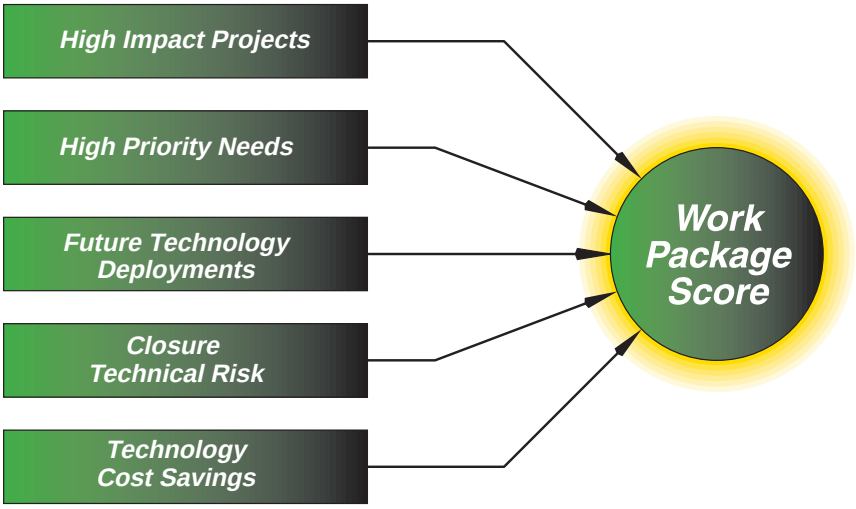


Figure 2.6 A five-attribute analysis determines work package score and priority order

Program Execution and Implementation - *Making It Work*

The final step in the OST program development process is to make the planned investments in research and development and then to ensure that the results are deployed in cleanup projects.

Program Execution - Creating Solutions

Each fiscal year, Congress provides funding to EM for cleanup projects and investments in research and development. Then research and development funds are allocated according to the integrated priority list. As a result, a set of work packages is authorized.

In general, a significant fraction of the investment portfolio is applied to the continuation of existing work scope, as most research and development activities are multi-year efforts. However, when new work scope is to be initiated, a determination must be made whether the product or service required will be made with in-house resources or procured from the private sector. This make-buy decision determines the type of procurement or award that will be used to commit the funding. If the product or service is to be made in-house, an existing Management & Operations (M&O), Management & Integration (M&I), or national laboratory research and development contract is used. If the product or service is to be procured from an external private sector or university source, either a competitive contract or a financial assistance procurement is awarded. Thus, the research and development portfolio is comprised of activities that are either the continuation of existing multi-year work scopes, or new work scope that is announced and competed as appropriate within the parameters of the competitive contracting vehicle being used. This competition ensures that the best talent is brought to bear on EM's key problems. The requests for proposals are conducted through either targeted or broad solicitations depending on work scope.

The investment portfolio is managed through the focus areas. This approach means that for any given problem area, the complete set of activities ranging from basic research to deployment, including technical assistance, is managed as an integrated investment. Although the basic research investments are administered through a partnership between the Environmental Management Science Program (EMSP) and the DOE Office of Science, the focus areas help identify the basic research needs the investments should address. The focus areas also help perform reviews of proposals to ensure that proposals are relevant to problem area needs. The focus area lead laboratories help establish and

maintain an interface with EMSP principal investigators to help coordinate and integrate the basic research activities with the continuum of technology development and maturation. To successfully integrate all the research and development activities, the focus areas must coordinate the research and development efforts of universities, national laboratories, industry, and site management contractors and also to be aware of other federal and state programs investing in related research and development.

The focus areas function as national programs. Therefore, they preferentially support research and development that addresses the needs of multiple EM sites. In general, national programs within DOE are complicated to manage because they require the cooperation of diverse sites that are progressing with cleanup under different schedules and regulatory requirements. In addition, no two waste streams, facilities, or site geologies are quite the same. The focus areas understand and take into account the differences among sites, whether they are regulatory, political, or technical, to ensure the rapid and widespread implementation of solutions. Focus Area User Steering Committees enhance programmatic integration and ensure adequate interaction and linkage of OST programs with the needs of the end users.

Successful development and maximum deployment of science and technology solutions depend upon effective communication between the end users, technology developers and vendors, and stakeholders and regulators. The focus areas form virtual or real "product teams" to create and facilitate the interfaces between these groups for effective communication. The product teams provide the mechanism for collecting and communicating information about available technologies to potential deployment sites and identify sources of deployment assistance. A product team may include appropriate OST site team and deployment assistance team representatives. The product team helps tailor the technology development to site-specific problems that a science or technology solution may help resolve.

Program Implementation - Delivering Solutions

Implementing solutions at the sites is the primary objective of EM's research and development investments. To meet the goals set in *Accelerating Cleanup: Paths to Closure*, the investment portfolio must enable or accelerate the cleanup effort and reduce cost and risk. Currently, there are literally hundreds of research and development activities within EM focused on performing cleanup better, safer, faster, and cheaper.

Though cleanup technologies are often developed at national laboratories, universities, or other private sector technology institutions, EM procures many cleanup services and equipment from commercial vendors through a competitive bidding process. Often large companies (or a team of companies) bid and win cleanup projects at DOE sites and use technologies from other companies (both large and small) in performing the work. Maximum benefit and deployment of technological innovations is most often achieved by transferring the innovation to the commercial sector for integration into the private sector suite of technological resources. Even if a new technology has been developed at a national laboratory or is an "in-house" product, it must be submitted to the competitive procurement process. Regardless of the source, a technology must stand on its own merits, be cost effective, and offer significant and desired advantages over other approaches without introducing unacceptable technical risk in order to be selected in a competitive procurement.

Deployment Assistance – Targeted Technical Support

The development of a new technology having superior performance compared to the baseline technology does not of itself guarantee that the technology will be deployed. In addition to technical excellence, issues such as the complexity of the technology, its compatibility with existing practices, the ease with which it can be used on a trial basis,

and the visibility of others' use of the technology all play significant roles in how quickly a technology is adopted — and, indeed, whether it is adopted at all. To help address these issues OST provides deployment assistance to increase the success of technology adoption at the various sites.

In addition to providing science and technology solutions to cleanup project managers, focus areas and their corresponding lead laboratories support technology deployment and provide technical assistance to EM line programs.

OST provides direct technical assistance on key technologies or critical products as required by end users and interfaces with both internal and external stakeholders to accelerate deployment of new technology. The deployment assistance offered by focus areas and the lead laboratory can be broken down into three critical areas:

- Problem/technology assessment,
- Project planning, and
- Verification, demonstration, and regulatory assistance.

To help bring the best science and technology to bear on solving the cleanup challenges facing the department, OST has formed a Deployment Assistance Team, within the Office of Technology Applications, at headquarters. The Deployment Assistance Team fosters partnerships and creates opportunities to facilitate accelerated and widespread deployment of new technological and scientific solutions by the focus areas and end users. They develop policies and procedures that help interface end users, regulators, technology vendors and technology developers to enable and ensure widespread use of new technologies.

Review and Evaluation - Ensuring a Quality and Focused Program

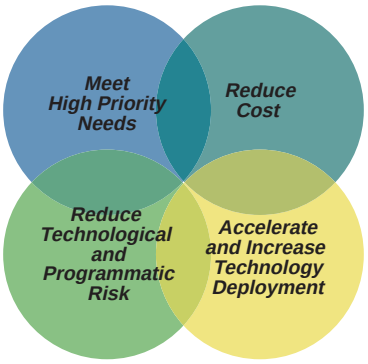
Reviews are one of the most important management processes and tools in the OST management approach. At the highest level, the performance of the OST program is measured against accomplishment of performance goals associated with the four critical objectives of the research and development program. These goals are part of the corporate performance goals of the department in the Secretary's Performance Agreement with the President, as prescribed by the Government Performance and Results Act (GPRA). Reviews are also used to help ensure good decisions are made during planning and implementation and also to evaluate and provide feedback regarding research and development progress and effectiveness. The quality of the research and development activities is assessed by scientific or technical merit reviews. Programmatic relevance is an assessment of the potential to meet science and technology needs.
.
Scientific merit is evaluated by independent peer reviewers from universities and DOE laboratories, selected on the basis of their professional qualifications and expertise. Proposals and progress reports (at significant decision points) are reviewed to ensure that the work objective and approach and the performers are appropriate and likely to provide the proposed results. Programmatic relevance reviews are used to determine if the proposed work is likely to contribute to achieving one or more of the EM cleanup-stewardship mission objectives.

The American Society of Mechanical Engineers (ASME) provides independent, external evaluation of the technical merits of a technology. These technical merit reviews are conducted at various stages of development and demonstration, providing important input to technology development managers for "go/no-go" decisions for project selection or project continuation.

Technical Assistance Activities

- ***Identify and implement alternative approaches and technologies***
- ***Evaluate technical alternatives to privatization projects***
- ***Review and select appropriate technologies***
- ***Solve immediate operational issues***
- ***Facilitate deployment of new technologies***

EM Program Critical Objectives



The National Academy of Sciences-National Research Council (NAS/NRC) conducts ad hoc reviews for EM. In addition to the NAS, the EM Advisory Board (EMAB) reviews programmatic aspects of EM investments in research and development. These ad hoc reviews generally address broad program issues and help guide EM in addressing problems of greatest significance to DOE. Most reviews culminate in written reports and an action plan that delineates steps to correct deficiencies or to take advantage of new opportunities. These reports provide valuable input for program planning and evaluation and are also used to document the progress and productivity of EM programs for DOE senior management, Congress, and the public.

EM Investments in Basic Research - Development, Implementation, and Execution

The development, implementation, and execution of EM's investments in basic research are accomplished through a partnership between EM and the DOE Office of Science. EM has the lead for soliciting research needs from the cleanup project managers, ensuring that selected research projects have application to DOE's cleanup problems, and ensuring that results of the research are communicated to cleanup project managers and contractor personnel having cleanup responsibilities. Although the focus areas have the responsibility to ensure that the basic science required for their problem area is identified and planned, the EMSP manages the financial aspects of the EM basic research investments, analogous to the administration of industry and university investments by the Industry and University Programs, respectively. The Office of Science manages the solicitation of research proposals and the scientific review process, and assists the focus areas with application and integration of the research program. The EMSP conducts needs analyses, provides financial management and procurement support, and serves as an interface with DOE field offices and the focus areas.

The EM-Office of Science partnership was created to ensure that EM basic research investments directly support development of new and improved solutions to DOE cleanup problems and that the research is scientifically meritorious. The call for research grant proposals is based on research needs identified by EM, focusing the EM basic research on intractable cleanup problems or problems needing better solutions. The Office of Science reviews the scientific merit of research proposals. Only proposals that successfully pass both reviews are considered for funding. Researchers are required to submit annual reports on the progress of the research projects.